



Lessons Learned for Anaerobic Digestion on Small Dairy Farms

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Nina Kshetry, UEM Inc.

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TYPES OF WATER & WASTEWATER TREATMENT SYSTEMS

Aerobic

Aerobic bacteria used to reduce organic pollutants that contribute to BOD & COD. Technologies include Activated Sludge Solutions, Extended Aeration, Membrane Bioreactors (MBR), Sequencing Batch Reactors (SBR), Moving Bed Bioreactors (MBBR)

Filtration

Removal of pollutants using filtration operating on the principles of particle size filtration, adsorption, or absorption.

Anaerobic

Anaerobic bacteria used to reduce organic pollutants that contribute to BOD & COD, typically used when pollutant concentrations are high. Technologies include Low Rate Reactors (Complete Mix, Plug Flow, Lagoon-based Systems), and High Rate Reactors (Anaerobic Hybrid Reactors, Upflow Anaerobic Sludge Blanket, Anaerobic Membrane Bioreactors)

Water Reclamation & Reuse

High-quality water reclamation solutions provide the ability to reuse wastewater for different applications, and in some cases wastewater is treated to drinking water quality standards. Technologies include Micro-filtration/ Ultra-filtration (MF/UF), Reverse Osmosis (RO), and Zero Liquid Discharge (ZLD) solutions

Nutrient Removal

Removal of nutrients such as Nitrogen and Phosphorous from wastewater using either biological treatment, chemical precipitation, or membrane treatment.

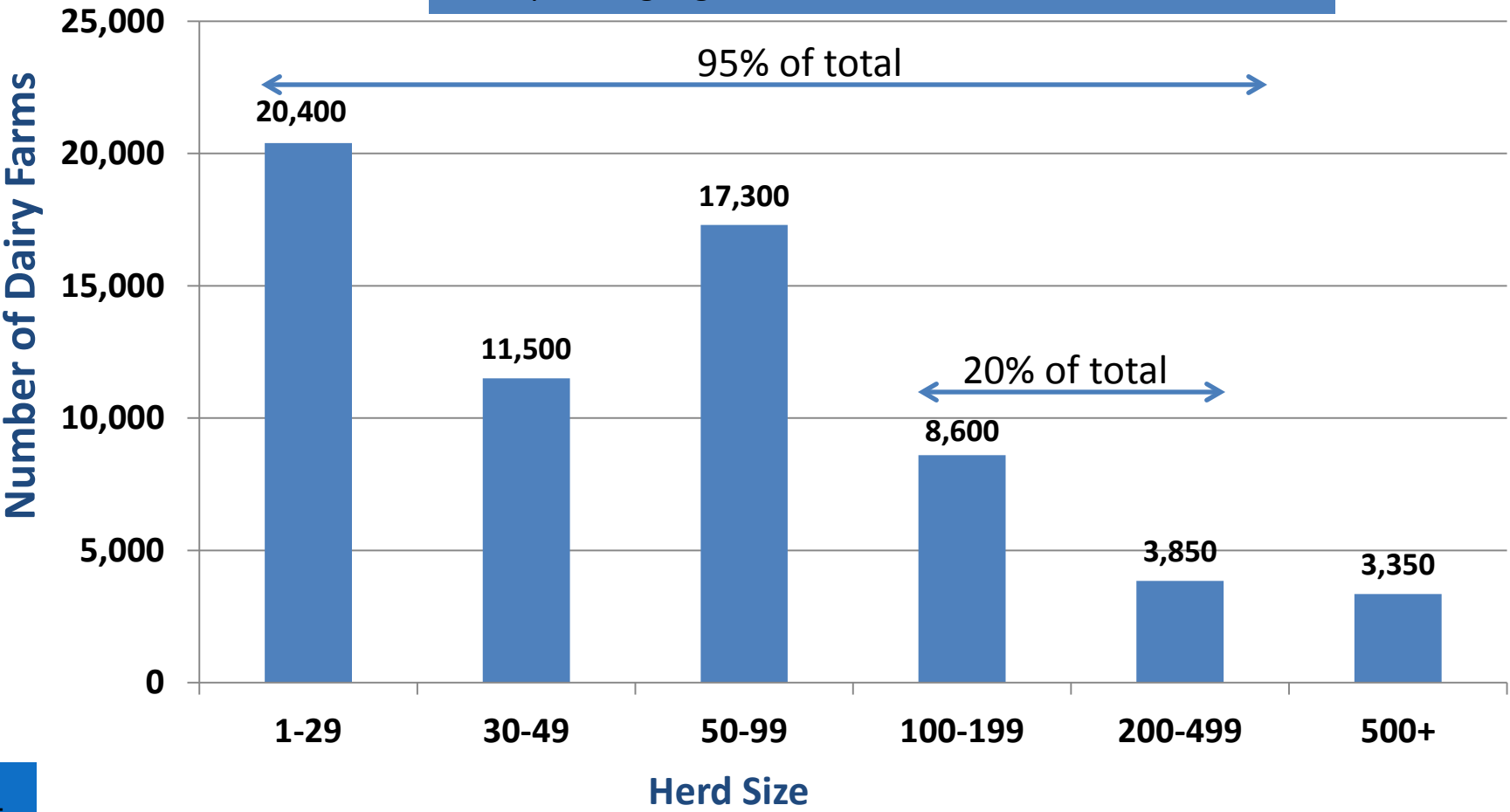
INDUSTRIES WITH ANAEROBIC DIGESTERS

- Distilleries
- Breweries
- Sugar
- Yeast
- Food Processing
- Beverage Bottling
- Fermentation
- Pharmaceuticals
- Citric Acid
- Pulp and Paper
- Man Made Fibers
- Palm Oil
- Petrochemicals
- Oil Refineries
- Soap and Cosmetics
- Domestic Sewage
- Terephthalic Acid (PTA)
- Starch

Growth Sectors Going Forward:
Animal Manure & Food Waste

US DAIRY FARM SIZE DISTRIBUTION

Average Herd Size = 115
Average Herd Size of Dairies with Digesters = 2,000
200 operating digesters



HURDLES FOR SMALL FARM DIGESTERS



1. Small-scale projects do not benefit from economies of scale, and digester cost per head of cattle tend to be prohibitively high.
2. Several fixed costs regardless of project size.
 - Grid Interconnection
 - Engineering Design
 - Project Management
 - Grant Application/Financing
3. Fewer small equipment suppliers/options.
 - Pre-processing equipment
 - Raw Manure Pumps & Agitators
 - Food Waste Decontamination
 - Power Generation Equipment
4. Larger projects can afford dedicated personnel to operate and maintain the plant, this is not possible on smaller installations unless several small projects in the same vicinity group together.

CAN WE STANDARDIZE TO REDUCE COSTS?



GOAL: To develop a low cost digester for small- to mid-sized dairy farms.

TARGET FARM

Dairy farms with 100 to 500 head of cattle

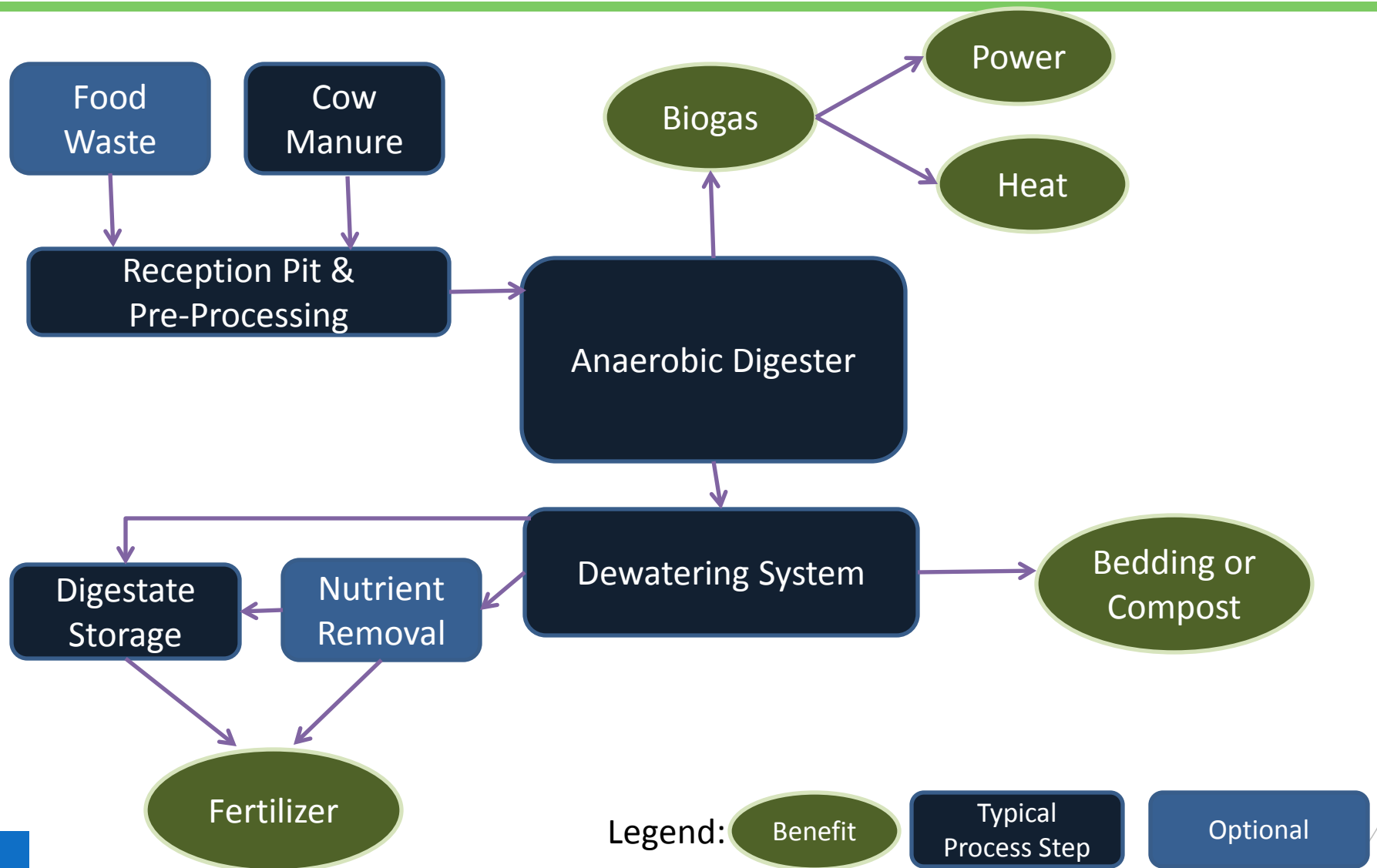
STANDARDIZE

- Eliminate customized engineering.
- Develop modular components.
- Reduce site works/construction.

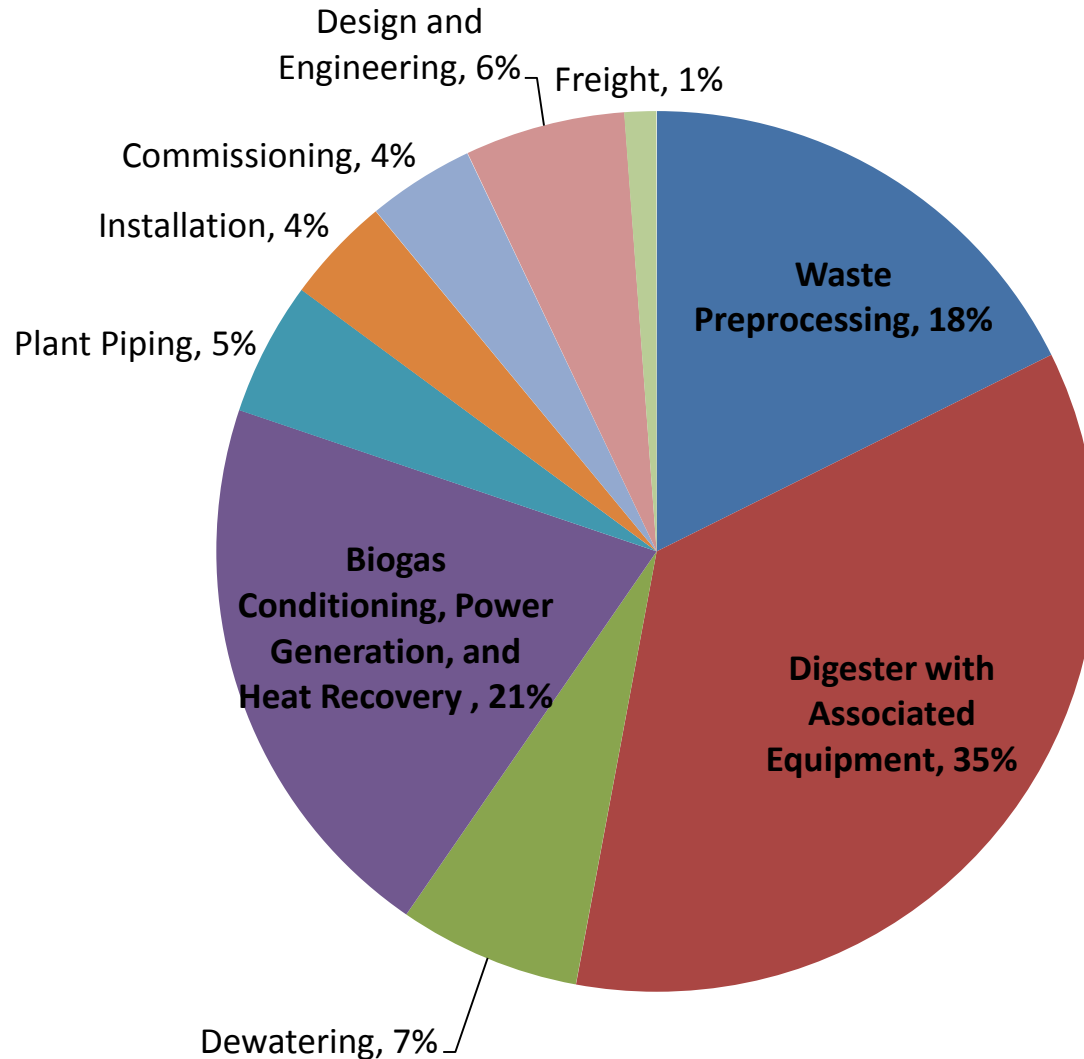
FARM BENEFITS

- Electricity production
- Heat production
- Animal bedding/organic fertilizer production
- Liquid fertilizer production
- Nutrient Removal
- Co-digestion
- Odor Reduction

TYPICAL PROCESS FLOW CHART



TYPICAL DIGESTER CAPITAL COST DISTRIBUTION



DESIGN CONSIDERATIONS FOR SMALL-SCALE SYSTEMS

1. Standardize Around the Following Three Packages:
 - Waste Pre-processing
 - Anaerobic Digester and Associated Electromechanical Equipment
 - Power/Heat Generation and Biogas Conditioning
2. Skid-based packages for Waste Pre-Treatment, Power Generation/Gas Conditioning, Electromechanical Equipment.
 - Common designs for different capacity ranges.
 - Eliminate redesigning for each new project.
 - Testing and commissioning prior to sending the equipment to site.
3. Standardized and modular digester tank and insulation.
 - Quick assembly time with minimal or no civil works.
 - Can be disassembled and moved to another site – portable design.

CASE STUDY: JONESLAN FARM DIGESTER, HYDE PARK, VT

PROFILE

- 220 Cattle Dairy Farm
- Scrape Manure Collection System, with Existing Manure Storage Tank
- Digester Sized for 320 Cattle for Future Expansion
- 65 KW Power Generation Capacity with Waste Heat Collection
- Solids Dewatering For Animal Bedding
- Liquid Fraction of Digestate Spread of Fields
- Credit for Excess Power at Retail Power Rates Due with Vermont Group Net Metering Law

RECEPTION PIT



EXCAVATED HOLE



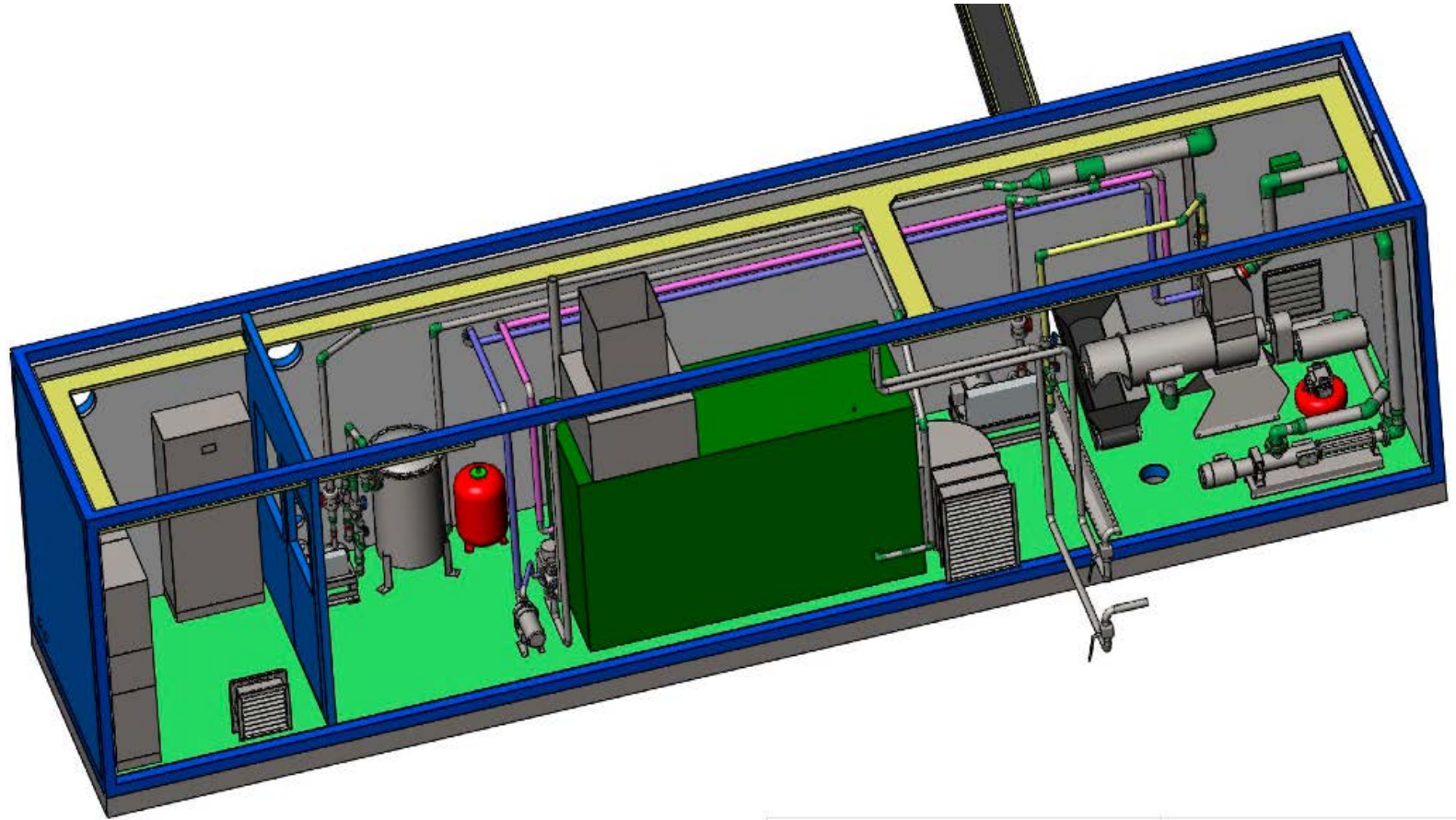
PREFABRICATED TANK LINER AND COVER



MODULAR INSULATION



PREFABRICATED EQUIPMENT AND CONTROLS



CONTAINER MODIFICATION



EQUIPMENT AND CONTROLS ROOM



THE FARMERS



Brian and Steve Jones – Owners of Joneslan Farm LLC

LESSONS LEARNED FROM JONESLAN



- Reduce concrete and site works even further.
- Use an above ground digester tank.
- Continue to provide prefabricated components, such as equipment room, control room, CHP system, digester tank, cover, and insulation.
- Simplify the electrical controls and components.

KEY DRIVERS FOR FARM DIGESTERS GOING FORWARD

- Co-digestion of Food Waste – Several states (VT, CA, MA, CT) are banning food waste from going to landfills, and this trend is likely to continue. Farm-based digesters are one option for treating food waste, and co-digestion of food waste provides a substantial increase in the revenue for digester projects.
- Nutrient Management – More stringent nutrient management laws are making it difficult for farmers in certain regions to continue to spread their manure on their fields. Digested liquids (post solids removal) can be treated for nutrient removal, and save the farmer fees in hauling the manure off-site.
- Favorable Policies – Feed-in-Tariffs, Carbon Credits, Group Net Metering

CONCLUSION

- If we are going to see more digester installations, we need to make digester systems affordable on smaller farms.
- Standardizing the design and reducing on-site activities, while focusing on simple and robust designs, is one approach to effectively reducing costs.
- Policies banning food waste from landfills can be a driver for agricultural digester projects due to the additional revenue from tipping fees.
- More stringent nutrient management policies can also be a driver for agricultural digester projects, especially with further digestate treatment.



For more information please contact:

Nina Kshetry

561-683-2273 Ext. 3#

nkshetry@uemgroup.com

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- A turnkey water and wastewater treatment firm with over 40 years of experience.
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